

What is claimed is:

1. A method for producing two domains within a liquid crystal layer by forming said liquid crystal layer with molecules thereof aligned vertically with respect to a substrate where the substrate has two electrodes separated from each other by a selected distance, and then applying an electric field between the two electrodes.

2. A method for producing two domains within a liquid crystal layer comprising the steps of:

forming a first electrode and a second electrode on a surface of a substrate, the electrodes being separated from each other by a selected distance;

forming a liquid crystal layer having liquid crystal molecules on the substrate surface with the liquid crystal molecules aligned vertically with respect to the substrate surface; and

applying an electric field between the two electrodes, wherein a domain boundary is formed midway between the electrodes within the liquid crystal layer.

3. The method of claim 2, wherein the step of forming the liquid crystal layer comprises steps of: forming a homeotropic alignment layer on the substrate surface on which the first and second electrodes are formed, and forming the liquid crystal layer on the homeotropic alignment layer.

4. A method for fabricating a liquid crystal display device, comprising the steps of:

providing a first substrate;

forming a first electrode and a second electrode on a surface of the first substrate;

forming a homeotropic alignment layer on the first substrate having the two electrodes thereon;

providing a second substrate;

forming a homeotropic alignment layer on a surface of the second substrate;

arranging the two substrates such that the homeotropic alignment layers of the two substrates face each other and are
5 separated by a selected distance; and

forming a liquid crystal layer within a space between the homeotropic alignment layers of the two substrates.

5. A method for fabricating a liquid crystal display device,
10 comprising:

providing a first substrate having an inner surface and an outer surface opposite the inner surface;

forming a first electrode and a second electrode on the inner surface of the first substrate;

15 forming a first homeotropic alignment layer on the inner surface of the first substrate, having the two electrodes formed thereon;

providing a second substrate having an inner surface and an outer surface opposite the inner surface thereof;

20 forming a second homeotropic alignment layer on the inner surface of the second substrate;

arranging the two substrates such that the two inner surfaces of the two substrates face each other separated by a selected distance;

25 forming a liquid crystal layer within a space between the substrates; and

forming an optical compensating plate on at least one outer surface of the two substrates.

30 6. The method of claim 5, further comprising, after the step of forming the optical compensating plate, the steps of disposing a polarizer outside the first substrate and disposing an analyzer outside the second substrate.

7. A liquid crystal display device comprising:
a base substrate having a surface;
a first electrode formed on the surface of the base

substrate;

a second electrode formed on the same surface of the base substrate, wherein the first electrode and the second electrode are spaced apart for application of an electric field therebetween;

5 a liquid crystal layer formed on the base substrate surface and including liquid crystal molecules, the liquid crystal molecules for alignment normal to the base substrate surface in an absence of the electric field between the two electrodes;

10 wherein in the presence of the electric field between the two electrodes, the molecules are tilted towards a central region between the two electrodes.

15 8. The liquid crystal display device of claim 7, further comprising a homeotropic alignment layer formed adjacent at least one of upper and lower surfaces of the liquid crystal layer.

20 9. The liquid crystal display device of claim 7, wherein the liquid crystal layer is formed of a material having a property of positive dielectric anisotropy.

25 10. The liquid crystal display device of claim 7, further comprising a second substrate together with said base substrate and said liquid crystal layer forming a panel upon which an optical compensating plate is formed.

30 11. The liquid crystal display device of claim 10, wherein the optical compensating plate is made of a negatively birefringent index liquid crystal film.

35 12. The liquid crystal display device of claim 7, wherein the first electrode is a pixel electrode, and the second electrode is a counter electrode.

13. The liquid crystal display device of claim 12, wherein

each of the pixel and counter electrodes is made of a transparent metal film.

14. The liquid crystal display device of claim 8, wherein the
5 liquid crystal layer is formed of a material having a property
of positive dielectric anisotropy.

15. The liquid crystal display device of claim 8, further
comprising a second substrate, together with said base
10 substrate and said liquid crystal layer forming a panel upon
which an optical compensating plate is formed.

16. The liquid crystal display device of claim 15, wherein
the optical compensating plate is made of a liquid crystal
film including the negatively birefringent index molecules.

17. The liquid crystal display device of claim 8, wherein the
first electrode is a pixel electrode, and the second electrode
is a counter electrode.

20 18. The liquid crystal display device of claim 17, wherein
each of the pixel and counter electrodes is made of a
transparent film.

25 19. A liquid crystal display device comprising:
a substrate;
a first electrode formed on a surface of the substrate;
a second electrode formed on the surface of the
substrate, wherein the first electrode and the second
30 electrode are spaced apart for application of an electric
field therebetween;
a liquid crystal layer formed on the surface of the
substrate and including liquid crystal molecules;
a homeotropic alignment layer formed adjacent at least
35 one of upper and lower surfaces of liquid crystal layer; and
an optical compensating plate formed on a layer on at
least one side of upper and lower portions of the liquid

crystal layer,

wherein in the presence of the electric field between the two electrodes, the molecules are tilted towards a central region between the two electrodes.

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20. The liquid crystal display device of claim 19, wherein the optical compensating plate is made of a liquid crystal film including a plurality of molecules of negatively birefringent index.

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21. The liquid crystal display device of claim 19, wherein the liquid crystal molecules have a property of positive dielectric anisotropy.

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22. The liquid crystal display device of claim 19, wherein the first electrode is a pixel electrode, and the second electrode is a counter electrode.

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23. The liquid crystal display device of claim 22, wherein each of the pixel and counter electrodes is made of a transparent metal film.

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24. A liquid crystal display device comprising:
a first substrate having an inner surface and an outer surface opposite the inner surface;
a second substrate disposed opposite the first substrate and having an inner surface and an outer surface opposite the inner surface;
a liquid crystal layer sandwiched between the inner surfaces of the two substrates and including liquid crystal molecules;
a first electrode and a second electrode formed on the inner surface of the first substrate, wherein the first electrode and the second electrode are spaced apart for application of an electric field therebetween;
homeotropic alignment layers respectively formed on the inner surface of the first substrate and on the inner surface

of the second substrate; and

an optical compensating plate disposed on at least one of the outer surfaces of the first and second substrates,

wherein in the presence of the electric field between the
5 two electrodes, the molecules are tilted from the respective electrodes towards a central region between the two electrodes.

25. The liquid crystal display device of claim 24, further
10 comprising a polarizer layer disposed outside the first substrate.

26. The liquid crystal display device of claim 25, further comprising an analyzer layer disposed outside the second
15 substrate.

27. The liquid crystal display device of claim 24, wherein
the optical compensating plate is made of a liquid crystal film including a plurality of molecules of negative
20 birefringent index.

28. The liquid crystal display device of claim 25, wherein an angle between an axis of the polarizer and a direction of the electric field is about 45 degrees.
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29. The liquid crystal display device of claim 26, wherein an angle between the axis of the polarizer and an axis of the analyzer is about 90 degrees.

30. The liquid crystal display device of claim 24, wherein the liquid crystal layer is formed of a material having a property of positive dielectric anisotropy.

31. The liquid crystal display device of claim 24, wherein
35 the first electrode is a pixel electrode, and the second electrode is a counter electrode.

32. The liquid crystal display device of claim 31, wherein each of the pixel and counter electrodes is made of a transparent metal film.

- 5 33. A liquid crystal display device, comprising:
- a first substrate having an inner surface and an outer surface opposite the inner surface;
- a second substrate having an inner surface and an outer surface opposite the inner surface and disposed opposite the
- 10 first substrate;
- a liquid crystal layer sandwiched between the inner surfaces of the two substrates and including liquid crystal molecules;
- a pixel electrode and a counter electrode formed on the inner surface of the first substrate, wherein the pixel electrode and the counter electrode are spaced apart for application of an electric field therebetween for aligning the liquid crystal molecules between the two electrodes along electric field lines of the electric field;
- 20 homeotropic alignment layers respectively formed on the inner surface of the first substrate and on the inner surface of the second substrate;
- a polarizer disposed on the outer surface of the first substrate;
- 25 an optical compensating plate disposed on the outer surface of the second substrate; and
- an analyzer disposed on the optical compensating plate, wherein
- in the presence of the electric field between the pixel electrode and the counter electrode, the molecules are tilted along said electric field lines towards a central region between the two electrodes where the liquid crystal molecules are aligned normal to the inner surfaces of the two substrates.
- 35 34. The liquid crystal display device of claim 33, wherein the liquid crystal layer is formed of a material having a

property of positive dielectric anisotropy.

35. The liquid crystal display device of claim 33, wherein an angle between an axis of the polarizer and a direction of the
5 electric field is about 45 degrees.

36. The liquid crystal display device of claim 33, wherein an angle between an axis of the polarizer and an axis of the analyzer is about 90 degrees.
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37. The liquid crystal display device of claim 33, wherein the optical compensating plate is made of a liquid crystal film including a plurality of molecules of negative birefringence index.
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38. The liquid crystal display device of claim 33, wherein each of the pixel and counter electrodes is made of a transparent metal film.
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39. A liquid crystal display device comprising:
a first substrate having an inner surface and an outer surface opposite the inner surface;
a second substrate having an inner surface and an outer surface opposite the inner surface and disposed opposite the first substrate;
30 a plurality of gate bus lines and a plurality of data bus lines intersecting the plurality of gate bus lines, arranged in a matrix configuration on a surface of the first substrate and defining a plurality of pixel regions each bounded by a pair of the plurality of gate bus lines and a pair of the plurality of data bus lines;

a liquid crystal layer sandwiched between the inner surfaces of the two substrates and including liquid crystal molecules;
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a pixel electrode and a counter electrode formed on the inner surface of the first substrate, wherein the pixel electrode and the counter electrode are spaced apart for

application of an electric field therebetween for aligning the liquid crystal molecules between the two electrodes along electric field lines of the electric field;

5 a plurality of switching devices corresponding respectively to the plurality of pixel regions, each of the plurality of switching devices being connected to a corresponding one of the plurality of data bus lines and a corresponding one of the plurality of pixel electrodes;

10 homeotropic alignment layers respectively formed on the inner surface of the second substrate and on the inner surface of the first substrate wherein the molecules are aligned normal to said inner surfaces of the two substrates in the absence of said electric field;

15 a polarizer disposed on the outer surface of the first substrate;

an optical compensating plate disposed on the outer surface of the second substrate; and

an analyzer disposed on the optical compensating plate, wherein

20 in the presence of the electric field between the pixel electrode and the counter electrode, the molecules are tilted along said electric field lines towards a central region between the two electrodes wherein the molecules remain aligned normal to said inner surfaces of the substrates.

25 40. The liquid crystal display device of claim 39, wherein the liquid crystal layer is formed of a material having a property of positive dielectric anisotropy.

30 41. The liquid crystal display device of claim 39, wherein an angle between an axis of the polarizer and a direction of the electric field is about 45 degrees.

35 42. The liquid crystal display device of claim 39, wherein an angle between an axis of the polarizer and an axis of the analyzer is about 90 degrees.

43. The liquid crystal display device of claim 39, wherein the optical compensating plate is made of a liquid crystal film including a plurality of molecules of negative birefringence index.

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44. The liquid crystal display device of claim 39, wherein each of the pixel and counter electrodes is made of a transparent metal film.